

A NEW SPECIES OF *LIRONECA* (ISOPODA; CYMOTHOIDAE) PARASITIC ON CICHLID FISHES IN LAKE TANGANYIKA

By R. J. LINCOLN

INTRODUCTION

ONLY three species of parasites belonging to the family Cymothoidae have been recorded from freshwater localities on the African continent. The first of these to enter the literature was *Ichthyoxenus expansus*, described by Van Name in 1920 as a parasite on the gills of the citharinid fish *Eugnathichthys eetweldii* Boulenger. This isopod has since been widely recorded from the waters of the Congo river basin (Monod, 1931; Darteville, 1939; Brian & Darteville, 1949 and Grosse, 1963). There has been much discussion in the past about the validity of the genus *Ichthyoxenus* to which *expansus* was referred. Miers (1880) expressed the opinion that the two genera *Ichthyoxenus* and *Lironeca* were indistinguishable, except that the former was exclusively freshwater. Van Name (1920) considered the wide separation of the localities from which the species of *Ichthyoxenus* had been described as evidence that they were not a monophyletic group, but were instead convergent forms. In this view the freshwater habitat has been adopted independently a number of times by some ancestral marine genus such as *Lironeca*. Monod (1931) also mentions the above points, but despite this the name *Ichthyoxenus* still seems to survive for certain freshwater species. More recently, Fryer (1965) adopts the view that the freshwater species have been derived from some common marine ancestor, and that morphologically they are indistinguishable from the widespread marine genus *Lironeca*. Fryer thus refers *expansus* to *Lironeca*, and considers *Ichthyoxenus* of Herklots 1870 to be a junior synonym of *Lironeca* Leach 1818.

Two further species are described by Fryer from Lake Tanganyika, *Lironeca tanganyikae* Fryer 1965 and *Lironeca enigmatica* Fryer 1968. The former species, *tanganyikae*, has been recorded only from the mouth cavity of the littoral cichlid fish *Simochromis diagramma* (Günther), while *enigmatica* was taken from the body and gill cavity of the clupeids *Limnothrissa miodon* (Boulenger) and *Stolonothrissa tanganicae* Regan.

An examination of a collection of the cichlid fishes *Lamprologus elongatus* Boulenger and *Lamprologus pleurostigma* Boulenger from Lake Tanganyika has provided a number of isopod parasites, with both mature male and female stages present. These specimens represent a hitherto undescribed species which I name *Lironeca africana*.

Lironeca africana sp. nov.

(Text-figs 1a-g, 2a-j, 3a-q)

MATERIAL EXAMINED. Holotype female, length 11.0 mm, ovigerous: allotype male found in association with holotype, length 5.0 mm: paratypes, 5, ♀♀, length 7.0-14.0 mm, width 3.5-5.0 mm; 4, ♂♂, length 4.0-5.5 mm, width 1.0-2.0 mm. All specimens deposited in the British Museum (Natural History), accession numbers; holotype, 1970 : 438; allotype, 1970 : 439; paratypes, 1970 : 440.

FEMALE, (holotype). Body size, length 11.0 mm, width 4.5 mm, height including the marsupium 4.0 mm. Shape of body in dorsal, ventral and lateral view given in Figs 1a, 2a, 1b respectively. Head, ratio of length to maximum width about 1 : 1.5, shape triangular, broadly rounded at the front and curved slightly downwards towards the base of the antennae; eyes large, laterally placed; head somewhat sunken into the peraeon; chromatophores evenly distributed on dorsal side of head. Peraeon tergite 1 about $1\frac{1}{2}$ times the length of tergite 2, tergites 2-6 subequal, tergite 7 only half length of tergite 6; peraeon tergite 1, antero-lateral projection reaching forward to mid-eye level, anterior and posterior margins broadly rounded; peraeon tergite 1 almost flat dorsally, tergites 2-7 becoming progressively more convex; maximum width of peraeon is reached by coxal plates of segment 4; coxal plates reach progressively nearer to posterior margin of tergites from 1-7; posterior margin of peraeon tergite 7 broadly rounded. Pleon immersed a little in peraeon tergite 7, all segments free laterally, length of segments increasing slightly from 1-5; posterior margin of pleon segment 4, and especially 5, sinuous. Telson, length twice width, broadly rounded, with ridge running from antero-lateral corners towards the centre.

Appendages; antenna 1 and 2 each with 7 segments, slender, rounded and only just reaching beyond forward projection of peraeon tergite 1, antenna 1 slightly longer than antenna 2 (Fig. 2b, c); mandible (Fig. 2d) with slender incisor process pointed at tip, molar process rounded, palp 3-segmented with 2-3 apical setae; maxilla 1 (Fig. 2e) slender, carrying 4 recurved spines on distal tip; maxilla 2 (Fig. 2f) small, bilobed, each lobe bearing a pair of hooked spines; maxilliped (Fig. 2g) well developed, broad, with a 2 segmented palp terminating in 4 strongly recurved spines. Peraeopods 1-7 of similar shape (Fig. 1c, d), basis and ischium strongly developed in anterior peraeopods, less so in posterior peraeopods, merus and carpus very short, propodus prominent, dactylus strongly curved and pointed, apex of dactylus fitting into a carpal groove, very well formed articulation between dactylus and propodus, no spines present on the peraeopods. Pleopods fleshy, leaf-like, without marginal setae (Fig. 1e, f); uropods (Fig. 1g), inner ramus just a little longer than outer, both rami apically rounded, projecting fractionally beyond margin of telson.

MALE, (allotype) found associated with holotype. The male is very much smaller than the female, length 5 mm, width 2 mm; general form of the body and appendages resemble the female, and reference will therefore be made only to the main points of difference. Shape of body in dorsal view as in Fig. 2h. Head with rounded eye lobes, produced forward into a short, somewhat square-ended rostrum, only weakly immersed into peraeon; peraeon slightly asymmetrical, tergite 1 is $1\frac{1}{2}$ times length

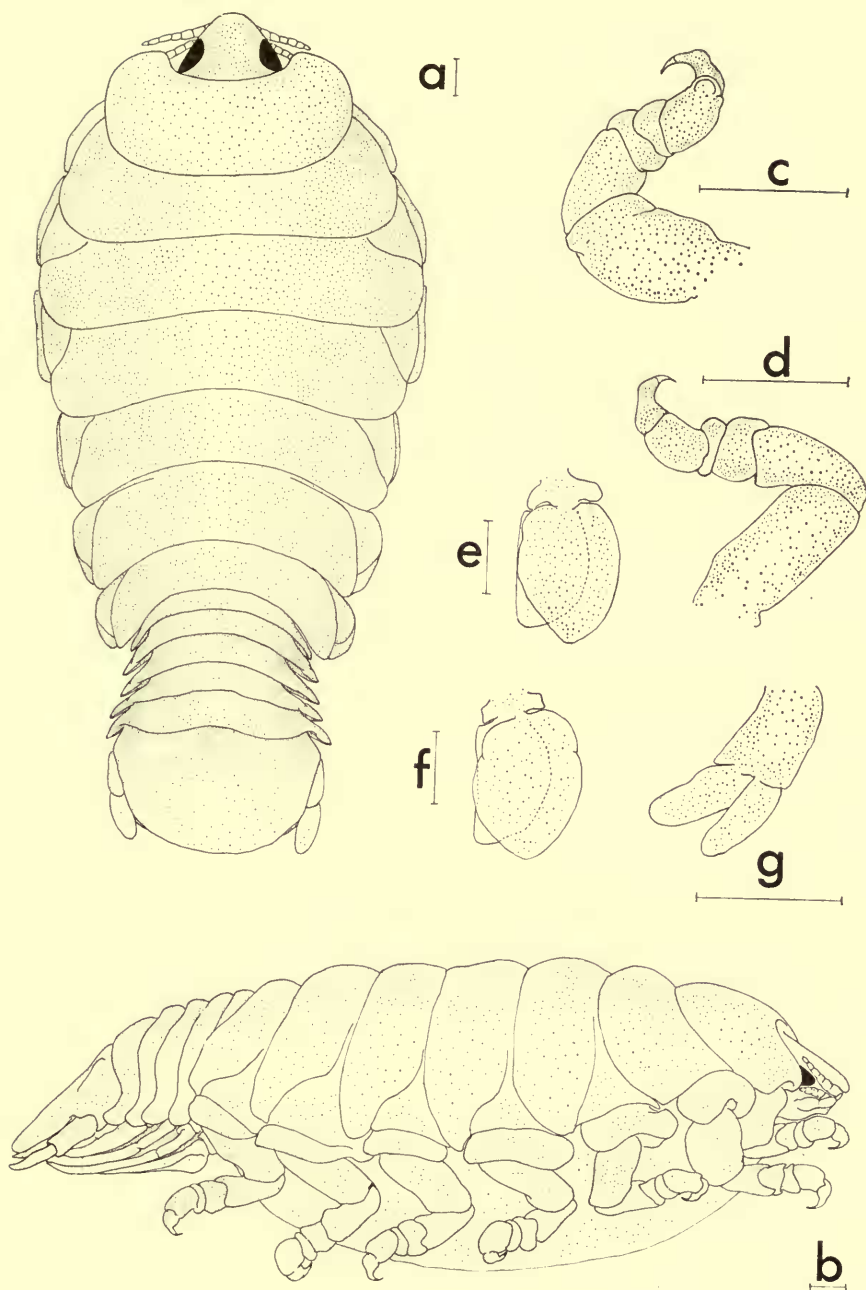


FIG. 1. *Lironeca africana* sp. nov. ♀ Holotype: a, body entire, dorsal view; b, body entire, lateral; c, pereopod 1 left, ventral view; d, pereopod 7 left, ventral view; e, pleopod 1 left, ventral view; f, pleopod 2 left, ventral view; g, uropod left, ventral view. Bar scale 1 mm.

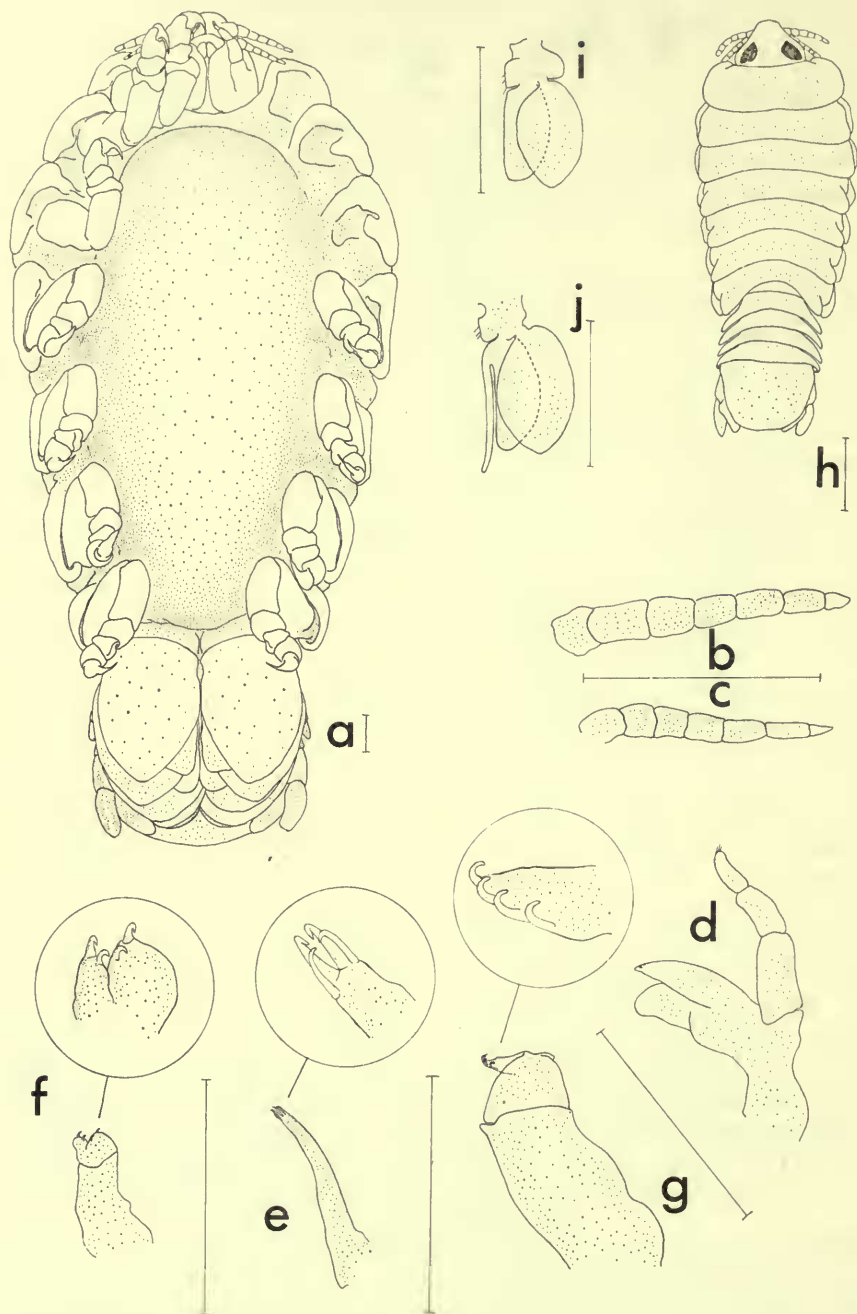


FIG. 2. *Livoneca africana* sp. nov. a-g ♀ Holotype: a, body entire, ventral; b, antenna 1; c, antenna 2; d, mandible; e, maxilla 1; f, maxilla 2; g, maxilliped; h-j ♂ allotype: h, body entire, dorsal; i, pleopod 1, left; j, pleopod 2, left. Bar scale 1 mm.

of tergites 2-7, maximum width at the level of segment 3, posterior margin of tergite 7 deeply rounded; paired penis lobes present on ventral surface of peraeon segment 7; chromatophores on both dorsal and ventral surface of peraeon; body less convex than the female. Pleon segment 1 immersed laterally in peraeon, segments 2-5 free; telson broad and flat, length about half of width, posterior corners round becoming straight in the centre.

Appendages; antenna 1 (Fig. 2h) rounded in cross section, 7 segmented; antenna 2 much narrower and consisting of 8 segments; mandible, maxilla 1, maxilla 2 and maxilliped as in female except the apical hooks are much less pronounced; pleopod 2, endopod, bearing appendix masculina (Fig. 2j), pleopod 1, fleshy and leaf-like (Fig. 2i).

First marsupial stage. This is mentioned only briefly as it is the structure of the second marsupial stage which is of greater interest. Body shape as in Fig. 3m; head not immersed in peraeon; peraeon tergite 1 with markedly sinuous posterior margin, segment 7 reduced in size and continuous with pleon; telson long and rounded, no marginal setae.

Appendages; antenna 1 consists of 7 segments, much dilated, without aesthetascs; antenna 2 of 8 segments, slender, slightly longer than antenna 1. Peraeopods 1-6 of similar size (Fig. 3n, o), no hooks or spines present. Pleopods 1-5 fleshy, no marginal setae; uropods projecting well beyond extremity of telson, no marginal setae or terminal spine (Fig. 3p, q).

Second marsupial stage. Body, length about 3 mm, width about 1 mm; 65 young specimens taken from the marsupium of a single female; shape in dorsal view as in Fig. 3a. Head with rounded eye lobes and forwardly produced rostrum as seen in the male; eyes large. Peraeon tergite 1 almost twice length of tergites 2-6, anterior and posterior margin of tergite 1 broadly rounded, segment 7 reduced and continuous with pleon, dorsal side of peraeon flattened; no penis lobes evident. Pleon rectangular, all segments free laterally; telson slightly longer than wide, rounded posterior margin bearing about 13 long plumose setae.

Appendages; antenna 1 (Fig. 3b) rounded in cross section and dilated, 7 segments, of which 4-7 carry prominent groups of aesthetascs; antenna 2 (Fig. 3b) slender, a little longer than antenna 1, 8 segmented with a small group of terminal setae; mandible, maxilla 1, maxilla 2, and maxilliped similar to those of female except much smaller and the terminal hooks evident only as small rounded tubercles. Peraeopods increasing in length very slightly from 1-7, basis and ischium well developed, merus and carpus short, propodus strong, and dactylus long, pointed, and sharply curved; peraeopods 1-3, merus with long spine-like seta on antero-lateral corner (Fig. 3c), also a characteristic number of hooks on inner side of each peraeopod, peraeopod 1-2 with a pair of hooks on propodus (Fig. 3c), peraeopods 3-4 have a pair of large hooks on propodus and a single curved spine on carpus (Fig. 3d), peraeopod 5 with two propodal and two carpal spines (Fig. 3e), peraeopod 6 bears two spines on propodus, three on carpus, and a single one on the merus (Fig. 3f). Pleopods bilobed (Figs 3g-k), leaf-like with long marginal plumose setae, setae absent from endopods of pleopods 3-5; peduncle of pleopods 1-5 each with a

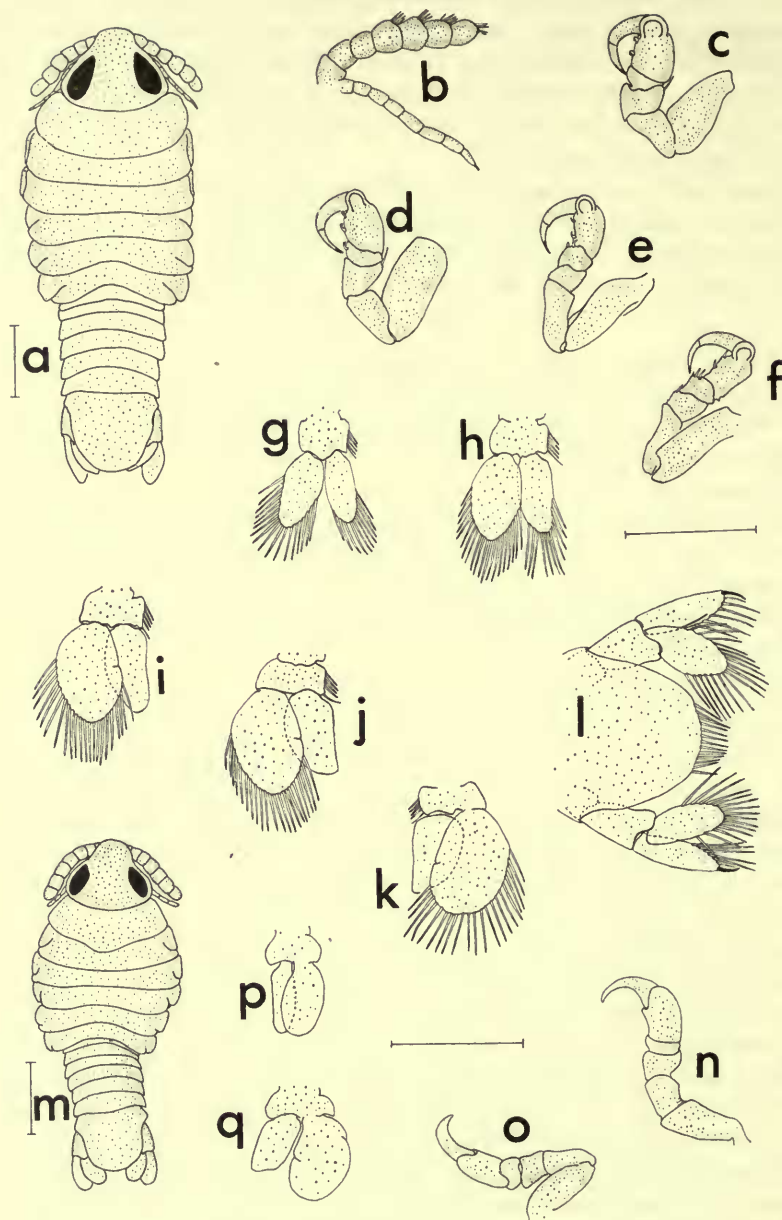


FIG. 3. *Livoneca africana* sp. nov. a-l, second marsupial stage: a, body entire, dorsal; b, antennae 1 & 2; c, pereopod 1, left; d, pereopod, 3, left; e, pereopod 5, left; f, pereopod 6, left; g, pleopod 1, left; h, pleopod 2, left; i, pleopod 3, left; j, pleopod 4, left; k, pleopod 5, left; l, uropod & telson entire. m-q, first marsupial stage; m, body entire, dorsal; n, pereopod 1, left; o, pereopod 6, left; p, pleopod 1, left; q, pleopod 2, left; bar scale 0.5 mm.

set of coupling spines; exact number of marginal setae on the pleopods is somewhat variable; uropods (Fig. 31) with long plumose setae, the exopod bearing a single large curved spine at the distal tip.

REMARKS. As might be expected in a group which shows marked polymorphism, there are some small morphological variations in the paratype material. It is important to appreciate this variability when attempting to identify material such as this, and the lack of such appreciation has undoubtedly been partly responsible for the very large number of species which have been described in the past.

The shape of the telson in females shows some variation from that of the holotype, and may be broad, almost rectangular, with a stright posterior margin. The peraeon in one of the specimens is asymmetrical, and there are some differences in proportional lengths of the peraeon tergites. The first tergite of the peraeon is not always markedly longer than tergites 2-6, but in all specimens the last tergite is reduced in length. In the holotype the peraeopods are all approximately the same length, while in the largest female paratype there is a small increase in the length of the peraeopods from 1-7, reflected in the size of the ischial segment, the length of the other segments remaining unchanged. In the males it is important to note that the body may show signs of asymmetry, and there is a wide range of body size, some specimens being very small.

The parasites were all taken from the mouth cavities of the cichlid fishes *Lamprologus elongatus* Boulenger and *Lamprologus pleurostigma* Boulenger. The fishes examined were part of an extensive collection taken from Lake Tanganyika and deposited in the collections of the British Museum (Natural History). The female parasite was attached to the tongue of the fish, with the long dactylae of the peraeopods embedded deeply into the tissues of the host. The isopod was situated with its head innermost, the posterior end of the body being about level with the angle of the host's jaw. Despite the large size of the parasite the fish was still able to close its mouth fully. The male parasite was found in close association with the female, attached either to the side of the mouth or the inside of the gill chamber. Only one male was found in the presence of each female.

Lironeca africana is readily distinguished from other freshwater African species by the general outline of the body and the contour of the posterior margin of peraeon tergite 7. *Lironeca expansus* is broadly elliptical in outline and the posterior margin of tergite 7 has a deeply concave contour, with the pleon strongly immersed into the peraeon. The head is also deeply set into the peraeon and projects very little, if any, beyond the general outline of the body. *Lironeca tanganyikae* has an oval outline, somewhat similar to *africana*, but the margin of tergite 7 is broadly convex with the median part straight. The pleon is only moderately immersed into the peraeon. In *Lironeca africana* the body is more elongate, the convex posterior margin of tergite 7 is an even curve, and the pleon is but weakly immersed. The characters mentioned above refer to the mature female stage.

The isopods belonging to the family Cymothoidae are protandrous hermaphrodites and it has been usual practice to base the description of a new species on the adult female stage. In the case of *Lironeca enigmatica*, described by Fryer from Lake

Tanganyika, the fully mature female was not available and the type series consists of a number of young male specimens varying both in size and in degree of development. The presence of setae on the pleopods and uropods indicates that these isopods were capable of free swimming, and it still remains to be shown whether or not the adult parasite is to be associated with the same species of fishes from which the *enigmatica* material was taken. Bearing this in mind, and appreciating the marked transformation which takes place when the parasite takes up permanent residence with the host, it could prove particularly difficult to establish the true identity of the adult female. To separate *enigmatica* and *africana* it is pointless to look at the male or female of the latter as they are no longer free swimming, and have lost all traces of pleopodal and uropodal setae. It only remains to compare *enigmatica* with the late marsupial stage of *africana*, which does have a full setal compliment in preparation for its early free swimming existence. These can easily be distinguished on the basis of the number of spines and hooks on the peraeopods and also the shape of the telson.

A close investigation of the characters possessed by the late marsupial juvenile stage of cymothoids may eventually provide an answer to some of the many problems which face the taxonomist working with this group. At the present time there are many genera which are separated on quite unreliable features and, as Fryer points out, it is quite possible to refer a given specimen to any of a number of genera. This has led to some genera receiving a large number of species, *Lironeca* being a good example, while others have remained monotypic.

ORIGIN OF LAKE TANGANYIKA ISOPOD FAUNA

The discovery of this parasite in association with cichlid fishes of the genus *Lamprologus* revives the question of the origin of the Lake Tanganyika isopod fauna. The cymothoids found in the Lake have very obvious affinities with marine members of the group, with which they no doubt share a common marine ancestral group. The problem is to establish when the isopods made their entry into the Lake and acquired freshwater status. Three main possibilities exist, although the first of these to be outlined can be said to have little support from present knowledge of the geology and biology of the Lakes region of eastern Africa. In a book '*The Tanganyika Problem*' published in 1903, Moore discussed the apparent affinities of the Lake fauna, with special reference to the molluscan groups, and arrived at the conclusion that the fauna had evolved from an ancient Jurassic marine stock which became isolated when the Lake was cut off from the sea. If the fauna originated in this way, the transition of the animals to a freshwater existence would have occurred within the Lake, and the parasites could have made the change in association with their fish hosts. But, as has been noted above this theory of the origin of the Lake fauna and of the Lake itself has now been largely abandoned.

From the evidence of the present distribution of the freshwater parasites it seems most likely that the isopods entered the Lake from a connection with the Congo river system. Lake Tanganyika is the only one of the Lakes in eastern Africa which is known to have the parasites, and the Congo River system is the only one of the rivers known to have a freshwater cymothoid fauna. If the isopods entered the

Lake region at a time before the isolation of Lake Tanganyika itself, one would expect to find them in some of the other bodies of freshwater, but this is not the case. It is now generally accepted that Tanganyika was formed sometime during the Pleistocene, but the question remains whether the isopods reached the Lake soon after its isolation, or whether they moved in from the Congo through some river connection in comparatively recent times. The evidence, limited as it is, tends to support the former possibility.

The two species of parasite found in the Lake for which a final host is known, *tanganyikae* and *africana*, are both associated with cichlid fishes, and show strict host specificity. This in itself suggests a long association, and the cichlid fishes represent a rich endemic element in the Tanganyika fauna. The third cymothoid known from the Lake, *enigmatica*, was taken from the clupeids *Stolonothrissa* and *Limnothrissa*, but these isopods were still juvenile and capable of free swimming, and the identity of their final host has not yet been established. Fryer (1968) points out that these clupeids have marine ancestors and the parasite may have made the transition to freshwater with the fish, and further suggests that this could represent a separate invasion of the Lake by the isopods. This cannot be disproved, but it is worth noting that the fishes in question are pelagic species which aggregate in large shoals, and are sufficiently abundant to be commercially exploited (Coulter 1970). Fish which move freely about the Lake and undergo marked diurnal migration would provide ideal dispersal for the juvenile free living stages of a parasite, and it seems quite probable that they are acting only as temporary intermediate hosts for the isopods. The fish are preyed upon by numerous carnivorous fish species, including some cichlids, and this may be the step by which the parasite reaches its final host. The speculation will remain until the adult *enigmatica* has been found, but if the view outlined above is found to be true, and the adult parasite is associated with a cichlid fish, it will be less of an enigma than the name was intended to suggest.

The cymothoid, *expansus*, found widely in the waters of the Congo, is without doubt a very close ally of the Tanganyika species. It too would seem to be host specific, on *Eugnathichthys eetweldii*, as I can find no record of it having been taken from any other fish, not even from a closely related species of the same citharinid fish genus which is also common in the Congo river.

The obvious affinities of the freshwater cymothoids in Africa one with another, and their very restricted distribution, indicates an entry into Lake Tanganyika from the Congo river system. The strict host specificity of the parasites and the endemism of the host fishes points to an early invasion of the Lake rather than an entry in more recent times. However, the nature of this brief summary must remain speculative until a great deal more is known of the isopods of the African continent.